

CLAIMS

1. (Currently amended) Process for producing ion exchange membranes, which comprises the steps of:
  - a) providing ~~Providing~~ a matrix material, comprising a polymeric component chosen from the group consisting of monomeric and oligomeric polymer precursors and cross-linkable polymers;
  - b) introducing ~~Introducing~~ in said matrix ion cation or anion exchange particles, or proton or hydroxyl or ion conducting particles or any combination thereof; ~~ion-exchange, proton, hydroxide and ion conductivity,~~ or cation or anion exchange polymers, or proton or hydroxyl or ion conducting polymers, or any combination thereof ~~ion-exchange, proton, hydroxide and ion conductivity~~;
  - c) mixing ~~Mixing~~ said particles or dissolving said polymer of step (b) with said matrix, wherein said particles or said polymers are used in amounts from 20 to 40 wt% of the combined amount of said matrix, and said particles or polymers;
  - d) forming ~~Forming~~ the resulting mixture into membrane configuration;
  - e) ordering ~~Ordering~~ by an electric field said particles or ordering by an electric field the domains of said polymer formed by polymer-matrix phase separation upon solvent evaporation or cooling, wherein said electric field has intensity from 50 to 20,000 V/cm; and
  - f) if ~~If~~ said matrix comprises or consists of a polymer precursor or a cross-linkable polymer, said precursor is cured concurrently with said ordering of

said particles, or if the matrix comprises a polymer solution or polymer melt the said polymer solution is evaporated or the said polymer melt is maintained and then cooled concurrently with said ordering of said particles;

wherein the resulting membrane thickness is between 10 to 500 microns.

2. (Original) Process according to claim 1, wherein the matrix material comprises or consists of a polymer.
3. (Original) Process according to claim 1, wherein the matrix material comprises or consists of a polymer precursor.
4. (Original) Process according to claim 3, wherein the polymer precursor is cured concurrently with said ordering of the ion exchange particles.
5. (Original) Process according to claim 1, wherein the introduction in the matrix of the ion exchange particles and the mixing of said particles with said matrix are carried out concurrently.
6. (Currently amended) Process according to claim 2, wherein said the polymer is ~~a material~~ homogeneously mixed with ion exchange particles either at elevated temperatures or when dissolved, and wherein said polymer is chemically resistant in acids and/or bases and/or oxidants.
7. (Currently amended) Process according to claim 3,

wherein the polymeric matrix is a material homogeneously mixed with ion exchange particles or polymers when not yet cured at elevated temperatures or when dissolved, and when cured ~~forms~~ a polymer is formed that is chemically resistant in acids and/or bases and or oxidants.

8. (Original) Process according to claim 1, wherein the polymeric matrix is chosen from the group consisting of polyethylene, polypropylene and polyamides.
9. (Original) Process according to claim 1, wherein the polymeric matrix is chosen from the group consisting of polyvinyl halogenated homo polymers, or copolymers, block-co- or tri- polymers or grafted polymers and engineering plastics.
10. (Currently amended) Process according to claim 9, wherein the polyvinyl halogenated polymers are chosen from the group consisting of comprising polyvinylidene fluoride ~~polyvinylidene fluoride~~ (PVDF), ~~polyvinylidene fluoride~~ PVDF copolymers, polyvinylidene chloride copolymers and polyvinyl chloride copolymers, ~~polyvinylidene fluoride~~ (PVDF), polytetrafluoroethylene (PTFE), polyhexafluoropropylene (PHFP), polychlorotrifluoroethylene (PCTF), and co- and ter-polymers of the above, such as PVDF-co-PTFE, PVDF-co-PTFE, PVDF-co-PHFP, PVDF-co-PCTF, poly(perfluoroalkyl dioxides) ~~Poly(perfluoroalkyl dioxides)~~ as a homopolymer and copolymers with other fluorinated monomers such as vinylidene fluoride or tetrafluoroethylene.

11. (Original) Process according to claim 1, wherein the ion exchange particles are chosen from among porous and non-porous particles and have an ion exchange capacity of 2 to 5 meq/g (dry basis) for the cation exchanges and of 1 to 3 meq/g (dry basis) for the anion exchangers.
12. (Original) Process according to claim 1, wherein the ion exchange particles have diameters from 0.2 to 200 microns.
13. (Currently amended) Process according to claim 12, wherein the ion exchange particles have diameters from 20 to 50 ~~50 to 20~~  $\mu\text{m}$ .
14. (Original) Process according to claim 1, wherein the ion exchange particles are in the nano-size range.
15. (Original) Process according to claim 1, wherein the ion exchange particles are spherically shaped beads.
16. (Original) Process according to claim 1, wherein the ion exchange particles are fibers, platelets or irregular shaped particles.
17. (Original) Process according to claim 1, wherein the ion exchange particles are in the form of a powder made of ground particles.
18. (Canceled)
19. (Canceled)

20. (Canceled)
21. (Canceled)
22. (Currently amended) Process according to claim 1 ~~21~~, wherein the electric field has intensity from 800 to 1500 V/cm.
23. (Original) Process according to claim 1, wherein the electric field is an alternating field.
24. (Original) Process according to claim 23, wherein the electric field has a frequency from 5 to 2000 Hz.
25. (Original) Process according to claim 24, wherein the electric field has a frequency from 20 to 150 Hz.
26. (Original) Process according to claim 1, wherein the electric field is a DC field.
27. (Original) Process according to claim 1, wherein the electric field is applied for periods up to 10 hours.
28. (Currently amended) Ion exchange ~~or ion conducting~~ membranes, according to claim 1, comprising a polymer matrix and ion cation or anion exchange particles, + or proton or hydroxyl or ion conducting particles; or any combination thereof ~~ion exchange, proton, hydroxide and ion conductivity~~; or domains of cation or anion exchange polymers, or proton or hydroxyl or ion conducting polymers, or any combination thereof ~~ion exchange, proton, hydroxide and ion conductivity~~,

wherein said domains occurred by matrix polymer incompatibility, and, wherein said particles or domains are generally ordered, wherein said membranes are optionally ion conducting membranes.

29. (Original) Ion exchange and ~~or~~ ion conducting membranes according to claim 28 ~~26~~, wherein the matrix comprises a material chosen from the group consisting of polyethylene, polypropylene, polyamides, polybenzimidazole, polysulfones, polyether sulfones, polyvinylidene fluoride, polyvinylidene fluoride copolymers, polyvinylidene chloride copolymers and polyvinyl copolymers; wherein the ion exchange and ~~or~~ conducting particles or domains have an ion exchange capacity of 0.5 to 5 meq/gr (dry basis) for the cation exchanges and of 1 to 3 meq/g (dry basis) for the anion exchangers, the diameters or the shortest dimension of which, are ranging from 0.002 to 200 microns, and their ~~are in amounts~~ are from 10 to 70 wt% of the membrane.
30. (Currently amended) Ion exchange and ~~or~~ ion conducting membranes according to claim 28 ~~26~~, having a configuration chosen from the group consisting of flat, tubular, capillary, or hollow fiber configurations.
31. (Currently amended) Ion exchange and ~~or~~ ion conducting membranes according to claim 28, having an improved passage of protons and a greater selective passage of protons compared to methanol or hydrogen gas compared to membranes wherein the particles or domains are not ordered.

32. (Withdrawn) Use of ion exchange membranes, comprising a polymeric matrix and ion exchange particles, wherein said particles are generally ordered in power sources.
33. (Withdrawn) Use of ion exchange or proton or hydroxyl or ion conducting membranes, comprising a polymeric matrix and ion exchange or conducting particles or ion exchange or proton or hydroxyl or ion conducting domains or any combination of ion exchange, proton, hydroxide and ion conductivity, wherein said membranes are used in power sources.
34. (Withdrawn) Use of ion exchange or ion conducting membranes according to claim 32, wherein the power sources are fuel cells.
35. (Withdrawn) Ion exchange membranes, comprising a polymeric matrix and ion exchange or conducting particles or domains or any combination of ion exchange, proton, hydroxide and ion conductivity,, wherein said particles or domains are generally ordered, for use in power sources.
36. (Withdrawn) Ion exchange membranes, comprising a polymeric matrix and ion exchange particles or domains, wherein said particles or domains are generally ordered, for use in fuel cells.
37. (Currently amended) Process according to claim 1, wherein the polymeric matrix is chosen from the following group of polymers, made by condensation polymerization:

polysulfone, polyphthalimidazole, polyether sulfone, polyphenylene sulfone, ~~polyetherketone~~, polyether ketone, ~~polyether ketone ether ketone~~, and other variations of polyether ketones and polysulfones, polyphenylene sulfide, phenylene sulfone and variations of sulfide and sulfone in the same polymer, polyethers based on polyphenylene oxide such as 2,6 dimethylphenylene, aromatic polyether imides, polyether amide-amide, aromatic polyamides and aromatic aliphatic polyamide combinations, polybenzimidazole, halomethylated derivatives of the above polymers on the aromatic or aliphatic groups.

38. (Previously presented) A fuel cell comprising a membrane according to claim 28.